rare and valuable gifts, for an examination of the table will show that the number of children which resemble their parents increases in this case with each successive generation. Thus the seed planted in 1867 from an ear with 18 rows produced 12.6 per cent. of 18 rowed children. The 18 rowed ear planted in 1868 from an 18 rowed parent cob produced 18.2 per cent. of 18 rowed children, and the 18 rowed seed planted in 1869 from 18 rowed parents and grandparents produced 18.6 per cent of 18 rowed children. The series is 12.6 per cent., 18.2 per cent., 18.6 per cent.

A percentage of 18 gifted children to the hundred may be discouraging to the "extravagant expectations of gifted parents that their children will inherit all their powers," but it is a most potent factor in the process of race modification by selection.

Müller's table shows, like Galton's observations, that the greatest number of children are not like the parents, but intermediate between them and the "type" or the average for the race. This is exhibited in the following table, in which the number of ears in the parent cob is given in the left-hand column, and the percentage of ears with the same number of rows, produced by the children in the second column, and the percentage of ears produced with the dominant number of rows in the third column.

1867	14	14 rows 35.6 %	12 rows 48 %
1867	16	16 " 18.7 %	14 " 48.6 %
1868	16	16 " 22.2 %	14 " 48.5 %
1867	18	18 " 12.6 %	14 " 37.8 %
1868	18	18 " 18.2 %	14 " 35 4 %
1869	18	18 " 18.6 %	14 " 37.3 %
1869	20	20 " 2.8 %	16 " 41.6 %
1869	22	22 " 1. %	16 " 41.8 %

It is thus seen that, like stature, the number of rows tends to revert to the type, but then it will also be seen that, in only three generations, the type itself may be so greatly modified by selection, that the minimum of the third generation may be equal to the mean of the first generation, and the mean of the third generation, 16 rows, is in this case very near the maximum for accidental ears.

W. K. BROOKS.

E'tudes experimentales sur les illusions statiques et dynamiques de direction pour serir a determiner les fonctions des canaux demi-circulaires. Par YVES DELAGE. Archives d' Zool. Exper. No. 4, 1886. pp. 535–624, (with index.)

Since the days of Flourens there have appeared few more valuable contributions to the physiology of the sense of equilibrium and of the semi-circular canals than this work of Professor Delage. The author goes far toward reconciling the conflicting opinions of those who, on the one hand, hold that the semi-circular canals are special spatial sense-organs, on whose activity depends every sense of position or direction of movement of the body; and of those who, on the other hand, think there is no good evidence of a normal relation between these organs and the sense of equilibrium. The general question is this: When the eyes are closed, through what sense or senses do we derive ideas of the direction of objects in

space, and of the position of our bodies with reference to them both while we are at rest and in motion? Since any sense-organ, when placed under abnormal conditions, may give rise to illusions dependent on such organ alone, a study of sensory illusions is a valuable aid in determining through what physiological channel any particular information is usually received. When visual sensations are excluded we still have distinct ideas of the direction of the various objects about us while our bodies are at rest, and of motion and direction of motion when our bodies are moved. The subject may, therefore, be conveniently divided into a study of *static* and *dynamic* sensations and illusions.

When the body is at rest and the eyes are closed what is the sense which gives us a knowledge of the direction of things in space? An observer standing upright, with eyelids closed and his visual axis directed straight forwards, can indicate without error the direction of any object in space and the position of the various parts of his own body. But if the head be turned as far as possible about one of its axes, the judgments of direction become false, and the observer points out directions as if external space had revolved through an angle of some fifteen degrees about the head in its normal position, and in the same plane, but in a direction opposite to that of the true motion. This indicates that the organ for which we depend for static sense of direction lies in the head. Is this organ the internal ear? If the observer turns his eyes alone, while the head remains at rest, illusion is the same as before; if the head is turned, while the eyes are forced to retain their original resting position, the illusion disappears. It can be shown that the illusion has its origin in the fact that when both head and eyes are turned the eyes unconsciously move through a greater angle than the head, which is equivalent to a positive rotation of the eyes within the unmoved head, and as this contraction of the eye-muscles gives rise to an unconscious sensation, it appears as if external space had rotated through an equal angle and in an opposite direction. It is concluded, therefore, that static sensations of direction comes as through the eye-muscle and not through the semi-circular canals.

Through what means do we gain a knowledge of the position of our bodies? If an observer, with eyes closed and the head in a normal position, is supported with his back upon a board which can be revolved about a horizontal axis, as the head end of the board is inclined toward the horizon, the observer rightly estimates his position when the inclination is about 60°; at angles of less value he judges his inclination to be slightly less than the reality, but after passing that angle the error rapidly increases in the other direction, so that when the board is inclined at an angle of 120°, the body seems to be vertical, with head downward. These results contradict those of Mach, whose experiments were performed in essentially the same manner. Sensations derived from the eye-muscles would tend to correct rather than increase this illusion of position, and sensations from the internal ear have no share in it, for the illusion can only be modified by altering the muscular and cutaneous sensations involved in the change of position.

It is concluded that our knowledge of the position of the body under these conditions depends upon muscular and cutaneous sensations, together with that general sensibility which appreciates the direction of gravitation of the fluids and internal organs of the body.

Dynamic sensations may be divided into those produced by rotation of the body and by simple translation in a straight line. We are very sensitive to movements of rotation imparted to our bodies. Our author, like previous observers, has found that when the motions are of short duration we can judge not only angular accelerations, but angular velocities, and the value of the angles traversed. It is only after prolonged rotation, a condition not experienced in ordinary life, that uniform motion is attended by failure of sensation with feeling of motion in the opposite direction after arrest. But even during continuous rotation, according to Delage, we are conscious of variations of velocity, and not, as held by Mach, of changes of acceleration alone. The movements of rotation were performed, with visual sensation excluded, round each of the three principal axis of the body. In turning round the vertical axis the observer was inclosed in a box to which air but no light was admitted, and which was suspended by two ropes, the twisting and untwisting of which gave any desired velocity of rotation. In movements round the other axes the observer was supported upon revolving table, which could be inclined at any desired angle. If, during a movement of rotation, the position of the head be changed with reference to the body, the axis of rotation itself appears to be changed in the same plane as the head, and with an equal angle, but in the opposite direction. We attribute to our body such a motion as it would have were it prolonged in its natural relation from the head in its new position. It seems clear from these facts that the organ which gives us sensations of rotation resides in the head. This organ cannot be the eye, for it was found that the ocular sensations produced by rotation are less powerful than those really experienced, and of the opposite sign. The semi-circular canals of the internal ear, from their anatomical structure and by the motor results following injury of them, seem to be the organs on which these sensations of rotation depend, and the current explanation of their operation through the excitement of their auditory nerve filaments, due to variation of endolymph pressure as the head is turned round its different axes, is probably the correct one.

The sensations produced, with eyes closed, by translation of the body in a straight line, are much less delicate than those aroused by rotation. When the movement is of short duration, a fairly correct judgment is formed of its velocity, amplitude and duration. When long continued, the sense of motion fails. Sudden arrest of the motion does not give a sensation of translation in the opposite direction There is no illusion as to the direction of motion when the position of the head alone is changed; therefore, the origin of the sensation is not in this part. The sensations of translation seem to have a general source, and depend upon the varied pressure of the internal organs and of the fluids throughout the body.

In brief, it may be said that M. Delage admits that the sense of equilibrium is supplied by sensations having several different sources. Besides the purely visual sensations, we depend for our knowledge of direction, either static or dynamic, upon feelings derived from the ocular muscles; upon sensations of touch, and upon general muscular sensibility; upon a feeling of the direction of pressure of the general fluids and of the internal organs of the body, as well as upon a special function of the semi-circular canals of the internal ear. The semi-circular canals are stimulated chiefly,

or only, by rotatory movements of the head, and seem to be special sense-organs for this kind of motion alone. Our appreciation of such motions is extremely delicate, as, indeed, should be expected when it is considered that it is upon movement of the head about one of its axes that we depend in every-day life for our judgments concerning our motions, and our change of position with reference to surrounding objects.

HENRY SEWALL.

Das Körperliche Gefühl. Ein Beitrag zur Entwickelungsgeschichte des Geistes. von Dr. EUGEN KRÖNER. Breslau, 1887. pp. 207.

The point of view from which this work is written is that of the naturalist and the evolutionist. As an outcome of the modern biological renaissance there has resulted the science of physiological psychology. To ensure the progress of this movement up to the stage of the exact sciences, two methods must be employed, the experimental (psycho-physics) and the comparative (genetic.) The latter is the method by which feeling is to be studied. The chief problems are—(1.) What psychic activities has the new-born infant? (2.) How are the faculties of the adult evolved from these? It is soon found that these problems are insoluble without the consideration of the development of psychic functions along the animal scale. As in bodily so in mental evolution, the two progress in parallel lines. Häckel's biogenetic law that "autogenesis, or the development of the individual, is a rapid and condensed repetition of the phylogenesis, or the development of the species," must be applied to psychology. Hence the importance of animal psychology and especially does this hold of the study of the feelings.

The lack of this genetic method of regarding emotional phenomena is the common fault of all historical systems, and one of the greatest obstacles in the way of such a conception was the conventional trinity of faculties with reason as the chief and fundamental. From the genetic point of view, feeling is the primary fact of life. It is the fundamental property common to all irritable tissue. The differentiation of subject and object, on which all reason depends, requires a more or less specialized sense organ, and such does not exist in the lower forms of life. The lowest stage in this evolution is represented by the conæsthesic feelings (Gemeingefühl). These are caused by the getting into consciousness of physiological activities, and are characterized by their vagueness—lack of localization—and by being pleasure-giving or the reverse. The first days of infant life are spent in this sphere. (Romanes puts the psychic life of a new-born child on a level with that of the coelenterata.) The next higher stage appears in sense-feeling (*sinnliche Gefühl, betonte Empfinding* of Herbart), in which the pleasurable or powerful effect is the concomitant of a more or less definite sensation. The distinction between the two is considered of radical importance.

The filling out of this plan is done with as great accuracy as our present knowledge will allow, while the treatment is everywhere interspersed with useful illustrative details. Theory is not resorted to when facts are the criterion, nor is introspection—nowhere so dangerous an instrument as here—allowed to rule over objective verifiable truth. Dr. Kröner's book may be recommended as the